IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of   :   Customer Number: 20277
                                              :
Craig HANSEN, et al.   :   Confirmation Number: 4587
                                              :
Patent No.: 7,301,541   :
Application No.: 10/616,303   :   Group Art Unit: 2628
                                              :
Issued: November 27, 2007   :
Filed: July 10, 2003   :   Examiner: WASHBURN, Daniel C.
                                              :
For: PROGRAMMABLE PROCESSOR AND METHOD WITH WIDE OPERATIONS

REQUEST FOR CERTIFICATE OF CORRECTION UNDER 37 CFR 1.323

Mail Stop Certificate of Correction
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

In reviewing the above-identified patent, printing errors were discovered therein requiring

correction in order to conform the Official Record in the application. The error was made in good

faith and was of a clerical or typographical nature or of minor character.

The errors noted are set forth on the attached copy of form PTO-1050 in the manner

required by the Commissioner's Notice.

Specifically, the first item (60) of the title page, line 1, incorrectly indicates the above-

identified patent is a "Continuation of application No. 09/922,319." Also, col. 1, lines 7-9 of the

specification incorrectly indicates the above-identified patent "is a continuation of U.S. patent

application Ser. No. 09/922,319." Although the above-identified patent is a continuing or

continuation application in the broad sense seen in, for example, MPEP § 201.07, more precisely

the above-identified is a continuation-in-part of Patent Application No. 09/922,319. Applicants respectfully request correction of the above-identified patent as set forth on the attached copy of form PTO-1050 to more precisely describe the chain of continuity for the above-identified patent, specifically its status as a continuation-in-part of Patent Application No. 09/922,319.

The examination record includes the following items pertaining to the requested correction:

- As originally filed on July 10, 2003, paragraph [0001] of the specification, in a portion entitled "Related Applications," stated that "This application . . . is a continuation-in-part of Patent Application No. 09/922,319" (*see* Attachment A). Thus, the correct information was provided to the Office.

- The filing receipt dated October 7, 2003 was consistent with this claim of priority, as it indicated Patent Application No. 10/616,303 "is a CIP of 09/922,319" (*see* Attachment B).

- On December 19, 2003, Applicants requested correction to the claim of priority, to correctly indicate that Patent Application No. 09/922,319 was filed on August 2, 2001. The document entitled "Correction to Claim of Priority" stated Patent Application No. 10/616,303 "is a continuation-in-part of Patent Application No. 09/922,319" (*see* Attachment C).

- Also on December 19, 2003, concurrent with the above "Correction to Claim Priority," Applicants filed a Preliminary Amendment amending paragraph [0001] of the specification to correctly indicate that Patent Application No. 09/922,319 was filed on August 2, 2001. However, due to a clerical error, this amendment indicated that "This application . . . is a continuation of U.S. Patent Application No. 09/922,319" (*see* Attachment D) (*emphasis added*).

2

- The file wrapper for the above-identified application includes a Bibliographic Data Sheet dated December 14, 2004 indicating, consistent with the "Correction to Claim of Priority" (*see* Attachment C), that Patent Application No. 10/616,303 "is a <u>CIP</u> of 09/922,319" (*see* Attachment E) (*emphasis added*). A subsequent Bibliographic Data Sheet dated May 4, 2005 also indicates it "is a <u>CIP</u> of 09/922,319" (*see* Attachment F) (*emphasis added*).

- In contrast, shortly before issuance of the above-identified patent, a Bibliographic Data Sheet dated October 26, 2007 indicated Patent Application No. 10/616,303 "is a <u>CON</u> of 09/922,319" (*see* Attachment G) (*emphasis added*).

- The above-identified patent issued on November 27, 2007 with the specification amended as requested in the Preliminary Amendment of December 19, 2003, and item (60) of the title page (entitled "Related U.S. Application Data") indicating the above-identified patent being a "Continuation of application No. 09/922,319" (*see* Attachment H).

The change of language in the Preliminary Amendment of December 19, 2003 from "continuation-in-part" to "continuation" was an inadvertent clerical error as demonstrated by (1) the lack of markup in the requested amendment to paragraph [0001] indicating an intentional change from "continuation-in-part" to "continuation," in contrast to markup provided for the change in date (*i.e.*, "<u>August 2, 2001</u> ~~March 24, 2000~~"); and (2) the concurrently filed "Correction to Claim of Priority" (*see* Attachment C) correctly indicated Patent Application No. 10/616,303 is a "continuation-in-part" of Patent Application No. 09/922,319.
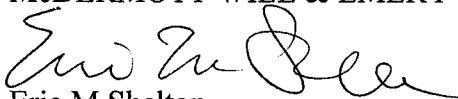
Please charge the $100.00 fee specified in 37 C.F.R. § 1.20(a) to our Deposit Account 500417.

3

Application No.: 10/616,303

Please charge any shortage in fees due in connection with the filing of this paper to Deposit

Account 500417 and please credit any excess fees to such deposit account.

Respectfully submitted,

McDERMOTT WILL & EMERY LLP

Eric M Shelton
Registration No. 57,630

600 13th Street, N.W.
Washington, DC 20005-3096
Phone: 202.756.8000 EMS:amz
Facsimile: 202.756.8087
Date: September 22, 2010

**Please recognize our Customer No. 20277
as our correspondence address.**

ATTACHMENT A

Paragraph [0001] of specification, as originally filed on July 10, 2003

SPECIFICATION

Related Applications

[0001]   This application claims the benefit of priority to Provisional Application No. 60/394,665 filed July 10, 2002, and is a continuation-in-part of Patent Application No. 09/922,319, filed March 24, 2000, which is a continuation of U.S. Patent Application No. 09/382,402, filed August 24, 1999, now U.S. Patent No. 6,295,599, which claims the benefit of priority to Provisional Application No. 60/097,635 filed on August 24, 1998, and which is a continuation-in-part of U.S. Patent Application No. 09/169,963, filed October 13, 1998, now U.S. Patent No. 6,006,318, which is a continuation of U.S. Patent Application No. 08/754,827, filed November 22, 1996 now U.S. Patent No. 5,822,603, which is a divisional of U.S. Patent Application No. 08/516,036, filed August 16, 1995 now U.S. Patent No. 5,742,840, each of the above applications and/or patents are herein incorporated by reference in their entirety.

Field of the Invention

[0002]   The present invention relates to general purpose processor architectures, and particularly relates to wide operand architectures.

REFERENCE TO A "SEQUENCE LISTING," A TABLE, OR A COMPUTER PROGRAM LISTING APPENDIX SUBMITTED ON A COMPACT DISK

[0003]   This application includes an appendix, submitted herewith in duplicate on compact disks labeled as "Copy 1" and "Copy 2." The contents of the compact disks are hereby incorporated by reference in their entirety.

BACKGROUND OF THE INVENTION

[0004]   Communications products require increased computational performance to process digital signals in software on a real time basis. Increases in performance have come

ATTACHMENT B

Filing receipt dated October 7, 2003

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPL. NO.	FILING OR 371 (c) DATE	ART UNIT	FIL FEE REC'D	ATTY.DOCKET NO	DRAWINGS	TOT CLMS	IND CLMS
10/616,303	07/10/2003	2183	0.00	43876-144	166	30	4

MCDERMOTT, WILL & EMERY
600 13th Street, N.W.
Washington, DC 20005-3096

RECEIVED
OCT 1 0 2003
MW&E

CONFIRMATION NO. 4587
FILING RECEIPT

OC000000010995887

Date Mailed: 10/07/2003

Receipt is acknowledged of this regular Patent Application. It will be considered in its order and you will be notified as to the results of the examination. Be sure to provide the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION when inquiring about this application. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please write to the Office of Initial Patent Examination's Filing Receipt Corrections, facsimile number 703-746-9195. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections (if appropriate).**

Applicant(s)

Craig Hansen, Los Altos, CA;
John Moussouris, Palo Alto, CA;
Alexia Massalin, Sunnyvale, CA;

San Jose

Domestic Priority data as claimed by applicant

This appln claims benefit of 60/394,665 07/10/2002
and is a CIP of 09/922,319 08/02/2001 *
which is a CON of 09/382,402 08/24/1999 PAT 6,295,599
which claims benefit of 60/097,635 08/24/1998
and is a CIP of 09/169,963 10/13/1998 PAT 6,006,318
which is a CON of 08/754,827 11/22/1996 PAT 5,822,603
which is a DIV of 08/516,036 08/16/1995 PAT 5,742,840
(*)Data provided by applicant is not consistent with PTO records.

Foreign Applications

If Required, Foreign Filing License Granted: 10/07/2003

Projected Publication Date: To Be Determined - pending completion of Missing Parts

Non-Publication Request: No

Early Publication Request: No

** SMALL ENTITY **

Title

Programmable processor and method with wide operations

Preliminary Class

712

LICENSE FOR FOREIGN FILING UNDER
Title 35, United States Code, Section 184
Title 37, Code of Federal Regulations, 5.11 & 5.15

GRANTED

The applicant has been granted a license under 35 U.S.C. 184, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" followed by a date appears on this form. Such licenses are issued in all applications where the conditions for issuance of a license have been met, regardless of whether or not a license may be required as set forth in 37 CFR 5.15. The scope and limitations of this license are set forth in 37 CFR 5.15(a) unless an earlier license has been issued under 37 CFR 5.15(b). The license is subject to revocation upon written notification. The date indicated is the effective date of the license, unless an earlier license of similar scope has been granted under 37 CFR 5.13 or 5.14.

This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data. Licensees should apprise themselves of current regulations especially with respect to certain countries, of other agencies, particularly the Office of Defense Trade Controls, Department of State (with respect to Arms, Munitions and Implements of War (22 CFR 121-128)); the Office of Export Administration, Department of Commerce (15 CFR 370.10 (j)); the Office of Foreign Assets Control, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

NOT GRANTED

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).

ATTACHMENT C

"Correction to Claim of Priority" filed on December 19, 2003
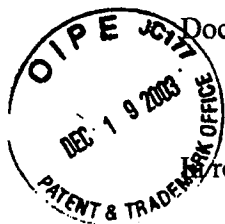
Docket No.: 43876-144   **PATENT**

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of   :

Craig HANSEN, et al.   :
                                              :
Serial No.: 10/616,303   :   Group Art Unit: 2183
                                              :
Filed: July 10, 2003   :   Examiner: Unknown
                                              :
For: PROGRAMMABLE PROCESSOR AND METHOD WITH WIDE OPERATIONS

CORRECTION TO CLAIM OF PRIORITY

Mail Stop MISSING PARTS
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

In response to the Filing Receipt mailed on October 7, 2003, which indicates a minor error

in the filing date of U.S. Application No. 09/922,319, please correct the identifying information in

the claim for priority filed on July 10, 2003 as follows:

In accordance with the provisions of 35 U.S.C. 120, Applicants hereby claim

the priority of U. S. Provisional Patent Application No. 60/394,665 filed July 10,

2002, and is a continuation-in-part of Patent Application No. 09/922,319, filed

August 2, 2001 ~~March 24, 2000~~, which is a continuation of U.S. Patent

Application No. 09/382,402, filed August 24, 1999, now U.S. Patent No.

6,295,599, which claims the benefit of priority to Provisional Application No.

60/097,635 filed on August 24, 1998, and which is a continuation-in-part of U.S.

Patent Application No. 09/169,963, filed October 13, 1998, now U.S. Patent No.

6,006,318, which is a continuation of U.S. Patent Application No. 08/754,827,

filed November 22, 1996 now U.S. Patent No. 5,822,603, which is a divisional of

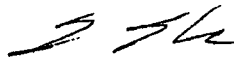U.S. Patent Application No. 08/516,036, filed August 16, 1995 now U.S. Patent No. 5,742,840.

The above correction to the filing date of U.S. Application No. 09/922,319 is being made in response to the identification of the error by the USPTO. A new priority claim has not been made by this minor correction. The priority claim is now believed to correspond to the USPTO records.

If there are any outstanding issues that might be resolved by an interview or an Examiner's amendment, the Examiner is requested to call Applicants' attorney at the telephone number shown below.

To the extent necessary, a petition for an extension of time under 37 C.F.R. 1.136 is hereby made. Please charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, to Deposit Account 500417 and please credit any excess fees to such deposit account.

Respectfully submitted,

MCDERMOTT, WILL & EMERY

Lawrence T. Cullen
Registration No. 44,489

600 13th Street, N.W.
Washington, DC 20005-3096
(202) 756-8000 LTC:
Facsimile: (202) 756-8087
Date: December 19, 2003
WDC99 856263-1.043876.0144

ATTACHMENT D

Page 2 of Preliminary Amendment filed on December 19, 2003

Amendments To The Specification

Please replace paragraph 0001 on page 2 and insert therein:

[0001] This application claims the benefit of priority to Provisional Application No. 60/394,665 filed July 10, 2002, and is a continuation of U.S. Patent Application No. 09/922,319, filed August 2, 2001 ~~March 24,2000~~, which is a continuation of U.S. Patent Application No. 09/382,402, filed August 24, 1999, now U.S. Patent No. 6,295,599, which claims the benefit of priority to Provisional Application No. 60/097,635 filed on August 24, 1998, and which is a continuation-in-part of U.S. Patent Application No. 09/169,963, filed October 13, 1998, now U.S. Patent No. 6,006,318, which is a continuation of U.S. Patent Application No. 08/754,827, filed November 22, 1996 now U.S. Patent No. 5,822,603, which is a divisional of U.S. Patent Application No. 08/516,036, filed August 16, 1995 now U.S. Patent No. 5,742,840, each of the above applications and/or patents are herein incorporated by reference in their entirety.

ATTACHMENT E

Bibliographic Data Sheet dated December 14, 2004

UNITED STATES PATENT AND TRADEMARK OFFICE

BIBDATASHEET

Bib Data Sheet

CONFIRMATION NO. 4587

SERIAL NUMBER 10/616,303	FILING DATE 12/19/2003 RULE	CLASS 345	GROUP ART UNIT 2676	ATTORNEY DOCKET NO. 43876-144

APPLICANTS

Craig Hansen, Los Altos, CA;

John Moussouris, Palo Alto, CA;
Alexia Massalin, San Jose, CA;

** CONTINUING DATA *** ~~Yes MM~~ ********************
This appln claims benefit of 60/394,665 07/10/2002
and is a CIP of 09/922,319 08/02/2001 PAT 6,725,356
which is a CON of 09/382,402 08/24/1999 PAT 6,295,599
which claims benefit of 60/097,635 08/24/1998
and is a CIP of 09/169,963 10/13/1998 PAT 6,006,318
which is a CON of 08/754,827 11/22/1996 PAT 5,822,603
which is a DIV of 08/516,036 08/16/1995 PAT 5,742,840

** FOREIGN APPLICATIONS *** ~~None HH~~ *************

IF REQUIRED, FOREIGN FILING LICENSE GRANTED
** 10/07/2003

Foreign Priority claimed ☐ yes ☑ no		STATE OR COUNTRY CA	SHEETS DRAWING 167	TOTAL CLAIMS 30	INDEPENDENT CLAIMS 4
35 USC 119 (a-d) conditions met ☐ yes ☑ no ☐ Met after Allowance					
Verified and Acknowledged Examiner's Signature Initials					

ADDRESS
MCDERMOTT, WILL & EMERY
600 13th Street, N.W.
Washington , DC
20005-3096

TITLE
Programmable processor and method with wide operations

		☐ All Fees	

h   e   e   e   e   e   c

ATTACHMENT F

Bibliographic Data Sheet dated May 4, 2005

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

BIBDATASHEET

Bib Data Sheet

CONFIRMATION NO. 4587

SERIAL NUMBER 10/616,303	FILING DATE 07/10/2003 RULE	CLASS 345	GROUP ART UNIT 2676	ATTORNEY DOCKET NO. 43876-144

APPLICANTS

Craig Hansen, Los Altos, CA;

John Moussouris, Palo Alto, CA;
Alexia Massalin, San Jose, CA;

** CONTINUING DATA ***~~~~~~~~~~~~~~~~~~~~~~~~
This appln claims benefit of 60/394,665 07/10/2002
and is a CIP of 09/922,319 08/02/2001 PAT 6,725,356
which is a CON of 09/382,402 08/24/1999 PAT 6,295,599
which claims benefit of 60/097,635 08/24/1998
and is a CIP of 09/169,963 10/13/1998 PAT 6,006,318
which is a CON of 08/754,827 11/22/1996 PAT 5,822,603
which is a DIV of 08/516,036 08/16/1995 PAT 5,742,840

** FOREIGN APPLICATIONS ***~~~~~~~~~~~~~~~~

IF REQUIRED, FOREIGN FILING LICENSE GRANTED
** 10/07/2003

Foreign Priority claimed ☐ yes ☑ no				
35 USC 119 (a-d) conditions met ☐ yes ☑ no ☐ Met after Allowance	STATE OR COUNTRY CA	SHEETS DRAWING 167	TOTAL CLAIMS 30	INDEPENDENT CLAIMS 4
Verified and Acknowledged Examiner's Signature Initials				

ADDRESS
MCDERMOTT, WILL & EMERY
600 13th Street, N.W.
Washington , DC
20005-3096

TITLE
Programmable processor and method with wide operations

			☐ All Fees

h   e   e   e   e   e   c

ATTACHMENT G

Bibliographic Data Sheet dated October 26, 2007

UNITED STATES PATENT AND TRADEMARK OFFICE

CONFIRMATION NO. 4587

Bib Data Sheet

SERIAL NUMBER 10/616,303	FILING OR 371(c) DATE 07/10/2003 RULE	CLASS 345	GROUP ART UNIT 2628	ATTORNEY DOCKET NO. 43876-144

APPLICANTS
Craig Hansen, Los Altos, CA;
John Moussouris, Palo Alto, CA;
Alexia Massalin, San Jose, CA;

** CONTINUING DATA ***************************
This appln claims benefit of 60/394,665 07/10/2002
and is a CON of 09/922,319 08/02/2001 PAT 6,725,356
which is a CON of 09/382,402 08/24/1999 PAT 6,295,599
which claims benefit of 60/097,635 08/24/1998
and is a CIP of 09/169,963 10/13/1998 PAT 6,006,318
which is a CON of 08/754,827 11/22/1996 PAT 5,822,603
which is a DIV of 08/516,036 08/16/1995 PAT 5,742,840

** FOREIGN APPLICATIONS ********************

IF REQUIRED, FOREIGN FILING LICENSE GRANTED
** 10/07/2003

Foreign Priority claimed ☐ yes ☐ no 35 USC 119 (a-d) conditions met ☐ yes ☐ no ☐ Met after Allowance Verified and Acknowledged _____ Examiner's Signature _____ Initials	STATE OR COUNTRY CA	SHEETS DRAWING 167	TOTAL CLAIMS 30	INDEPENDENT CLAIMS 4

ADDRESS
20277

TITLE
PROGRAMMABLE PROCESSOR AND METHOD WITH WIDE OPERATIONS

FILING FEE RECEIVED 1466	FEES: Authority has been given in Paper No. _____ to charge/credit DEPOSIT ACCOUNT No. _____ for following:	☐ All Fees
		☐ 1.16 Fees (Filing)
		☐ 1.17 Fees (Processing Ext. of time)
		☐ 1.18 Fees (Issue)
		☐ Other _____
		☐ Credit

ATTACHMENT H

U.S. Patent No. 7,301,541 (issued November 7, 2007):
title page and cols 1 and 2 of specification

(12) **United States Patent**
Hansen et al.

(10) **Patent No.:** **US 7,301,541 B2**
(45) **Date of Patent:** **Nov. 27, 2007**

(54) **PROGRAMMABLE PROCESSOR AND METHOD WITH WIDE OPERATIONS**

(75) Inventors: **Craig Hansen**, Los Altos, CA (US); **John Moussouris**, Palo Alto, CA (US); **Alexia Massalin**, San Jose, CA (US)

(73) Assignee: **Microunity Systems Engineering, Inc.**, Santa Clara, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 106 days.

(21) Appl. No.: **10/616,303**

(22) Filed: **Jul. 10, 2003**

(65) **Prior Publication Data**

US 2004/0098548 A1 May 20, 2004

Related U.S. Application Data

(60) Continuation of application No. 09/922,319, filed on Aug. 2, 2001, now Pat. No. 6,725,356, which is a continuation of application No. 09/382,402, filed on Aug. 24, 1999, now Pat. No. 6,295,599, which is a continuation-in-part of application No. 09/169,963, filed on Oct. 13, 1998, now Pat. No. 6,006,318, which is a continuation of application No. 08/754,827, filed on Nov. 22, 1996, now Pat. No. 5,822,603, which is a division of application No. 08/516,036, filed on Aug. 16, 1995, now Pat. No. 5,742,840.

(60) Provisional application No. 60/394,665, filed on Jul. 10, 2002, provisional application No. 60/097,635, filed on Aug. 24, 1998.

(51) **Int. Cl.**
G06F 9/30 (2006.01)
G06T 1/00 (2006.01)

(52) **U.S. Cl.** 345/522; 712/208; 712/209; 712/210

(58) **Field of Classification Search** 712/208–210, 712/24, 28, 32, 34; 345/536–538, 561, 562, 345/522
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,025,772 A 5/1977 Constant

(Continued)

FOREIGN PATENT DOCUMENTS

CA 1 323 451 10/1993

(Continued)

OTHER PUBLICATIONS

IEEE Draft Standard for "Scalable Coherent Interface-Low-Voltage Differential Signal Specifications And Packet Encoding", IEEE Standards Department, P1596.3/D0.15 (Mar. 1992).

(Continued)

Primary Examiner— Ulka Chauhan
*Assistant Examiner*—Daniel C. Washburn
(74) *Attorney, Agent, or Firm*—McDermott Will & Emery LLP

(57) **ABSTRACT**

A programmable processor and method for improving the performance of processors by expanding at least two source operands, or a source and a result operand, to a width greater than the width of either the general purpose register or the data path width. The present invention provides operands which are substantially larger than the data path width of the processor by using the contents of a general purpose register to specify a memory address at which a plurality of data path widths of data can be read or written, as well as the size and shape of the operand. In addition, several instructions and apparatus for implementing these instructions are described which obtain performance advantages if the operands are not limited to the width and accessible number of general purpose registers.

15 Claims, 167 Drawing Sheets

Wide Embedded Cache Coherency
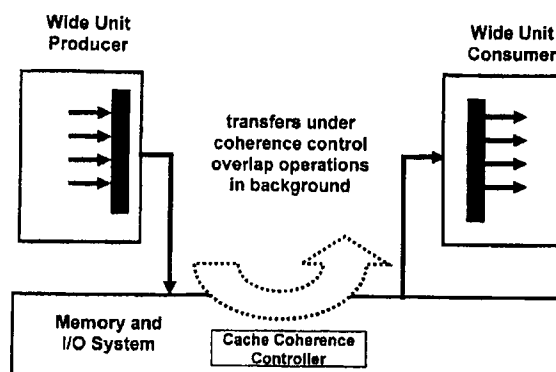
PROGRAMMABLE PROCESSOR AND METHOD WITH WIDE OPERATIONS

RELATED APPLICATIONS

This application claims the benefit of priority to Provisional Application No. 60/394,665 filed Jul. 10, 2002, and is a continuation of U.S. patent application Ser. No. 09/922, 319, filed Aug. 2, 2001 now U.S. Pat. No. 6,725,356, which is a continuation of U.S. patent application Ser. No. 09/382, 402, filed Aug. 24, 1999, now U.S. Pat. No. 6,295,599, which claims the benefit of priority to Provisional Application No. 60/097,635 filed on Aug. 24, 1998, and which is a continuation-in-part of U.S. patent application Ser. No. 09/169,963, filed Oct. 13, 1998, now U.S. Pat. No. 6,006, 318, which is a continuation of U.S. patent application Ser. No. 08/754,827, filed Nov. 22, 1996 now U.S. Pat. No. 5,822,603, which is a divisional of U.S. patent application Ser. No. 08/516,036, filed Aug. 16, 1995 now U.S. Pat. No. 5,742,840, each of the above applications and/or patents are herein incorporated by reference in their entirety.

FIELD OF THE INVENTION

The present invention relates to general purpose processor architectures, and particularly relates to wide operand architectures.

REFERENCE TO A "SEQUENCE LISTING," A TABLE, OR A COMPUTER PROGRAM LISTING APPENDIX SUBMITTED ON A COMPACT DISK

This application includes an appendix, submitted herewith in duplicate on compact disks labeled as "Copy 1" and "Copy 2." The contents of the compact disks are hereby incorporated by reference in their entirety.

BACKGROUND OF THE INVENTION

Communications products require increased computational performance to process digital signals in software on a real time basis. Increases in performance have come through improvements in process technology and by improvements in microprocessor design. Increased parallelism, higher clock rates, increased densities, coupled with improved design tools and compilers have made this more practical. However, many of these improvements cost additional overhead in memory and latency due to a lack of the necessary bandwidth that is closely coupled to the computational units.

The performance level of a processor, and particularly a general purpose processor, can be estimated from the multiple of a plurality of interdependent factors: clock rate, gates per clock, number of operands, operand and data path width, and operand and data path partitioning. Clock rate is largely influenced by the choice of circuit and logic technology, but is also influenced by the number of gates per clock. Gates per clock is how many gates in a pipeline may change state in a single clock cycle. This can be reduced by inserting latches into the data path: when the number of gates between latches is reduced, a higher clock is possible. However, the additional latches produce a longer pipeline length, and thus come at a cost of increased instruction latency. The number of operands is straightforward; for example, by adding with carry-save techniques, three values may be added together with little more delay than is required

for adding two values. Operand and data path width defines how much data can be processed at once; wider data paths can perform more complex functions, but generally this comes at a higher implementation cost. Operand and data path partitioning refers to the efficient use of the data path as width is increased, with the objective of maintaining substantially peak usage.

The last factor, operand and data path partitioning, is treated extensively in commonly-assigned U.S. Pat. Nos. 5,742,840, 5,794,060, 5,794,061, 5,809,321, and 5,822,603, herein incorporated by reference in their entirety, which describe systems and methods for enhancing the utilization of a general purpose processor by adding classes of instructions. These classes of instructions use the contents of general purpose registers as data path sources, partition the operands into symbols of a specified size, perform operations in parallel, catenate the results and place the catenated results into a general-purpose register. These patents, all of which are assigned to the same assignee as the present invention, teach a general purpose microprocessor which has been optimized for processing and transmitting media data streams through significant parallelism.

While the foregoing patents offered significant improvements in utilization and performance of a general purpose microprocessor, particularly for handling broadband communications such as media data streams, other improvements are possible.

Many general purpose processors have general registers to store operands for instructions, with the register width matched to the size of the data path. Processor designs generally limit the number of accessible registers per instruction because the hardware to access these registers is relatively expensive in power and area. While the number of accessible registers varies among processor designs, it is often limited to two, three or four registers per instruction when such instructions are designed to operate in a single processor clock cycle or a single pipeline flow. Some processors, such as the Motorola 68000 have instructions to save and restore an unlimited number of registers, but require multiple cycles to perform such an instruction.

The Motorola 68000 also attempts to overcome a narrow data path combined with a narrow register file by taking multiple cycles or pipeline flows to perform an instruction, and thus emulating a wider data path. However, such multiple precision techniques offer only marginal improvement in view of the additional clock cycles required. The width and accessible number of the general purpose registers thus fundamentally limits the amount of processing that can be performed by a single instruction in a register-based machine.

Existing processors may provide instructions that accept operands for which one or more operands are read from a general purpose processor's memory system. However, as these memory operands are generally specified by register operands, and the memory system data path is no wider than the processor data path, the width and accessible number of general purpose operands per instruction per cycle or pipeline flow is not enhanced.

The number of general purpose register operands accessible per instruction is generally limited by logical complexity and instruction size. For example, it might be possible to implement certain desirable but complex functions by specifying a large number of general purpose registers, but substantial additional logic would have to be added to a conventional design to permit simultaneous reading and bypassing of the register values. While dedicated registers have been used in some prior art designs to increase the

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO   : 7301541   Page 1 of 1

APPLICATION NO. : 10/616,303

ISSUE DATE   : November 27, 2007

INVENTOR(S)   : Craig HANSEN, et al.

It is certified that an error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

On the title page, in first Item (60) ("Related U.S. Application Data"), first line, please delete "Continuation of application No. 09/922,319", and add --Continuation-in-part of application No. 09/922,319--.

At col. 1, line 8, please delete "continuation", and add --continuation-in-part--.

MAILING ADDRESS OF SENDER (Please do not use customer number below):

600 13th Street, N.W.
Washington, D.C., DC 20005-3096